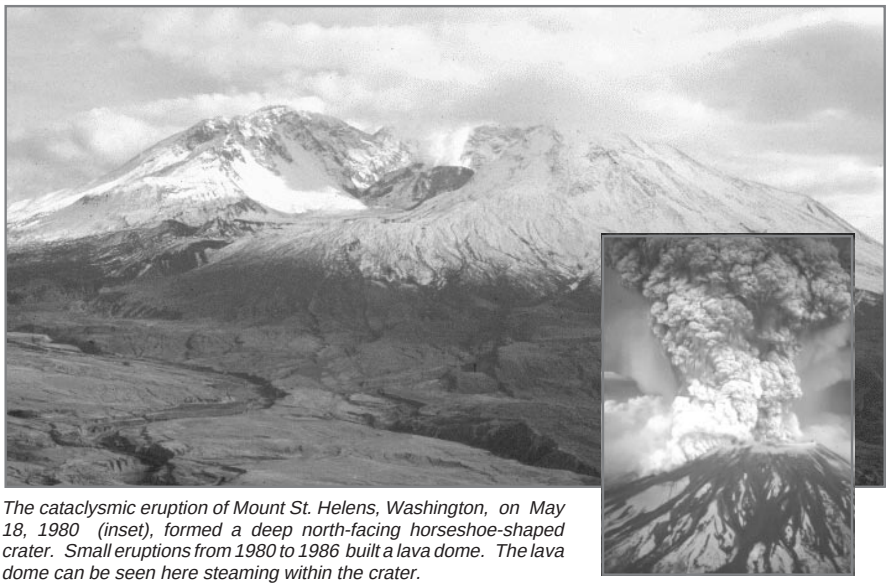
Mount St. Helens — From the 1980 Eruption to 1996

Mount St. Helens, Washington, is the most active volcano in the Cascade Range. Its most recent series of eruptions began in 1980 when a large landslide and powerful explosive eruption created a large crater, and ended 6 years later after more than a dozen extrusions of lava built a dome in the crater. Larger, longer lasting eruptions have occurred in the volcano's past and are likely to occur in the future. Although the volcano seems to have returned to a period of quiet, scientists with the U.S. Geological Survey and University of Washington Geophysics Program continue to closely monitor Mount St. Helens for signs of renewed activity.



The cataclysmic eruption of Mount St. Helens, Washington, on May 18, 1980 (inset), formed a deep north-facing horseshoe-shaped crater. Small eruptions from 1980 to 1986 built a lava dome. The lava dome can be seen here steaming within the crater.

THE VOLCANO AWAKENS

March 16 – May 17, 1980

The first sign of activity at Mount St. Helens in the spring of 1980 was a series of small earthquakes that began on March 16. After hundreds of additional earthquakes, steam explosions on March 27 blasted a crater through the volcano's summit ice cap. Within a week the crater had grown to about 1,300 feet in diameter and two giant crack systems crossed the entire summit area. By May 17, more than 10,000 earthquakes shook the volcano and the north flank grew outward at least 450 feet to form a noticeable bulge. Such dramatic deformation of the volcano was strong evidence that molten rock (magma) had risen high into the volcano.

CATACLYSMIC ERUPTION

May 18, 1980

Within 15 to 20 seconds of a magnitude 5.1 earthquake at 8:32 a.m., the volcano's bulge and summit slid away in a huge landslide — the largest in recorded history. The landslide depressurized the volcano's magma system, triggering powerful explosions that ripped through the sliding debris. Rocks, ash, volcanic gas, and steam were blasted upward and outward to the north. This lateral blast of hot material accelerated to at least 300 miles per hour, then slowed as the rocks and ash fell to the ground and spread away from the volcano; several people escaping the blast on its western edge were able to keep ahead of the advancing cloud by driving 65 to 100 miles an hour! The blast cloud traveled as far as 17 miles northward from the volcano and the landslide traveled about 14 miles west down the North Fork Toutle River.

The lateral blast produced a column of ash and gas (eruption column) that rose more than 15 miles into the atmosphere in only 15 minutes. Less than an hour later, a second eruption column formed as magma erupted explosively from the new crater. Then, beginning just after noon, swift avalanches of hot ash, pumice, and gas (pyroclastic flows) poured out of the crater at 50 to 80 miles per hour and spread as far as 5 miles to the north. Based on the eruption rate of these pyroclastic flows, scientists estimate that the eruption reached its peak between 3:00 and 5:00 p.m. Over the course of the day, prevailing winds blew 520 million tons of ash eastward across the United States and caused complete darkness in Spokane, Washington, 250 miles from the volcano.

During the first few minutes of this eruption, parts of the blast cloud surged over the newly formed crater rim and down the west, south, and east sides of the volcano. The hot rocks and gas quickly melted some of the snow and ice capping the volcano, creating surges of water that eroded and mixed with loose rock debris to form volcanic mudflows (lahars). Several lahars poured down the volcano into river valleys, ripping trees from their roots and destroying roads and bridges.

The largest and most destructive lahar was formed by water seeping from inside the huge landslide deposit through most of the day. This sustained flow of water eroded material from both the landslide deposit and channel of the North Fork Toutle River. The lahar increased in size as it traveled downstream, destroying bridges and homes and eventually flowing into the Cowlitz River. It reached its maximum size at about midnight in the Cowlitz River about 50 miles downstream from the volcano.

EXPLOSIONS AND DOME GROWTH

May 25 – October 16, 1980

Five smaller explosive episodes occurred during the summer and fall of 1980. Each produced eruption columns 8 to 9 miles above sea level and pyroclastic flows down the volcano's north flank. The episodes in June, August, and October also erupted lava in the crater to form a dome. Lava domes are mound-shaped features that form when stiff, viscous lava accumulates over and around a volcanic vent. The June and August domes were destroyed by subsequent explosive episodes.

October 16, 1980 – October 21, 1986

Beginning with the October 1980 eruption, 17 eruptive episodes built a new lava dome that reached 876 feet above the crater

Summary of May 18, 1980 Eruption of Mount St. Helens

Volcano	
Elevation of summit	9,677 feet before; 8,363 feet after; 1,314 feet removed
Volume removed*	0.67 cubic miles (3.7 billion cubic yards)
Crater dimensions	1.2 miles (east-west); 1.8 miles (north-south); 2,084 feet deep
Crater floor elevation	6,279 feet
Landslide	
Area and volume*	23 square miles; 0.67 cubic miles (3.7 billion cubic yards)
Depth of deposit	Buried North Fork Toutle River to average depth of 150 feet (max. depth 600 feet)
Velocity	70 to 150 miles per hour
Lateral Blast	
Area covered	230 square miles; reached 17 miles northwest of the crater
Volume of deposit*	0.046 cubic miles (250 million cubic yards)
Depth of deposit	From about 3 feet at volcano to less than 1 inch at blast edge
Velocity	At least 300 miles per hour
Temperature	As high as 660° F (350° C)
Energy release	24 megatons thermal energy (7 by blast, rest through release of heat)
Trees blown down	4 billion board feet of timber (enough to build about 300,000 two-bedroom homes)
Human fatalities	57
Lahars	
Velocity	About 10 to 25 miles per hour (over 50 miles per hour on steep flanks of volcano)
Damaged	27 bridges, nearly 200 homes
Effects on Cowlitz River	Reduced carrying capacity at flood stage at Castle Rock from 76,000 cfs (cubic feet per second) to less than 15,000 cfs
Effects on Columbia River	Reduced channel depth from 40 to 14 feet; stranded 31 ships in upstream ports
Eruption Column and Cloud	
Height	Reached about 80,000 feet in less than 15 minutes
Downwind extent	Spread across US in 3 days; circled Earth in 15 days
Volume of ash*	0.26 cubic miles (1.4 billion cubic yards)
Ash fall area	Detectable amounts of ash covered 22,000 square miles
Ash fall depth	10 inches at 10 miles downwind (ash and pumice); 1 inch at 60 miles downwind; 1/2 inch at 300 miles downwind
Pyroclastic Flows	
Area covered	6 square miles; reached as far as 5 miles north of crater
Volume & depth*	0.029 cubic miles (155 million cubic yards); multiple flows 3 to 30 feet thick; cumulative depth of deposits reached 120 feet in places
Velocity	Estimated at 50 to 80 miles per hour
Temperature	At least 1,300° F (700° C)

* Volumes are based on uncompacted deposits

Eruptions Since May 18, 1980

Date*	Explosive activity	Pyroclastic flows	Lava flows (dome)	Lahars	Erupted volume (million cubic yards)
05/25/80	X	X			
06/12/80	X	X	X		
07/22/80	X	X			
08/07/80	X	X	X		
10/16/80	X	X	X		1.6
12/27/80			X		2.1
02/05/81			X		4.7
04/10/81			X		5.4
06/18/81			X		5.4
09/06/81			X		5.1
10/30/81			X		4.7
03/19/82	m		X	X	4.4
05/14/82			X		3.5
08/18/82			X		6.0
02/07/83**	m		X	X	29.3
03/29/84			X		1.4
06/17/84			X		1.2
09/10/84			X		4.8
05/24/85			X	m	5.6
05/08/86			X		7.6
10/21/86			X		8.0

m Minor

* Explosive activity usually lasted hours and dome-building usually lasted days

** Dome growth continued for almost a year

Lava Dome, 1996

Elevation of top of dome: 7,155 feet
Height: 876 feet above 1980 crater floor
Diameter: About 3,500 feet
Volume: 97 million cubic yards

floor. Minor explosive activity and (or) lahars accompanied several of the 1981 to 1985 episodes. Each of the dome-building episodes added between 1 and 29 million cubic yards of new lava to the dome. Most of the growth occurred when magma extruded onto the surface of the dome, forming short (650 to 1,300 feet), thick (65 to 130 feet) lava flows. During a 12-month long episode beginning in 1983, however, magma moved primarily into the dome's molten interior, pushing its east side outward by at least 250 feet. In addition to the 17 dome-building episodes, hundreds of small explosions or bursts of gas and steam occurred, sending ash a few hundred feet to several miles above the volcano. The larger explosions showered the crater with rocks and occasionally generated small lahars.

November 1986 – 1996

The most significant activity since late 1986 consisted of about 30 periods of brief but intense seismic activity (lasting minutes to hours) that occurred in 1989 to 1991. Some of this seismicity was accompanied by small explosions from the dome. The explosions formed a new vent on the north side of the dome and produced small eruption columns that rose a few miles above the volcano. Some explosions also hurled hot rocks three feet in diameter at least 1/2 mile northward from the dome, generated small pyroclastic flows in the crater, and formed small lahars. These explosions were most likely related to the release of volcanic gas from magma still cooling beneath the dome.

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See also *What are Volcano Hazards?* (USGS Fact Sheet 002-97)

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